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APPLICATION

FOR

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TITLE: ELECTROCHEMICALLY POLISHING CONDUCTIVE FILMS ON SEMICONDUCTOR WAFERS

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ELECTROCHEMICALLY POLISHING CONDUCTIVE FILMS ON SEMICONDUCTOR WAFERS

Background

This invention relates generally to processing integrated circuits.

In the course of semiconductor wafer fabrication, a metal film formed on a semiconductor wafer may be polished. Conventionally, electrochemical polishing may be utilized. An abrasive fluid may be applied between the metal surface of the semiconductor wafer and a polishing platen. A potential may be applied between the semiconductor wafer and the polishing platen and the platen and semiconductor wafer may be counter rotated. As a result, the metal film may be polished.

Generally electropolish processes need uniform electrical contact to the metal film being polished. One limitation of electropolish processes is that the electrical contact to the film is made via contact to the edge of the wafer or at a few discrete points on the front of the wafer.

Thus, the electropolish process is dependent on the resistance of the film between the contact point and the area of the film being polished. As the film is thinned, the resistance of the film increases and eventually the film becomes discontinuous. As a result, the removal

process is significantly slowed and may subsequently be halted in some areas.

Thus, conventional electropolish processes suffer from an inability to remove the entire metal film due to the increase in resistivity at the end of the process. Patches of metal may remain at the end of the conventional process.

Thus, there is a need for better ways to implement electrochemical polishing.

Brief Description of the Drawings

Figure 1 is a side elevational view of one embodiment of the present invention;

Figure 2 is a partial, greatly enlarged, top plan view of a portion of the pad in accordance with one embodiment of the present invention; and

Figure 3 is an enlarged, partial, vertical, cross-sectional view through a portion of the wafer pad and platen shown in Figure 1 in accordance with one embodiment of the present invention.

Detailed Description

Referring to Figure 1, a semiconductor wafer 10 with a downwardly facing conductive surface may be rotated in a first direction indicated by a counterclockwise arrow. An electropolish platen 14 and pad 12 may be rotated in the opposite direction indicated by a clockwise arrow. As a

result, the conductive film on the wafer 10 may be electropolished.

In some cases, an abrasive polish fluid material may be used between the semiconductor wafer 10 and the pad 12. Pressure may or may not be exerted.

Referring to Figure 2, the upper surface of the pad 12 includes an array of regularly spaced, cut-out regions 16a. In one embodiment, these cut-out regions 16a have the circular configuration shown in Figure 2. As a result, electrical contact may be made through the pad 12 to the conductive surface of the semiconductor wafer 10. At the same time, an electric field may be applied through the cut-out region 16a to the conductive surface of the semiconductor wafer 10. Therefore, electrical contact can be made directly to the conductive film on the semiconductor wafer 10 and an electric field may still be applied to that wafer.

Referring to Figure 3, the platen 14 may have a passage formed therethrough which allows a feedthrough 20 to provide electrical communication to a counter electrode 16. The counter electrode 16 is exposed by the cut-out region 16a formed in the pad 12. Thus, an electrical potential may be supplied through the platen 14 (from the bottom side) to the electrode 16 to set up an electric field between the conductive film 22 of the semiconductor

wafer 10 and the counter electrode 16. The conductive film 22 may be a metal layer to be polished in one embodiment.

An insulative film 24 separates the feedthrough 20 and the counter electrode 16 from the pad 12 and the platen 14. In one embodiment, the pad 12 and the platen 14 are electrically conductive so that an electrical potential may be conveyed through the platen 14 to the pad 12 and thereafter to the film 22. Thus, the film 22 is at one polarity and the counter electrode 16 is at another polarity, setting up an electric field. The circularly shaped edge of the cut-out region 16a may be effective in providing a polishing action.

An electrical potential may be provided through the insulative film 24 upwardly from below to the feedthrough 20 to the electrode 16 in one embodiment of the present invention. A potential of the opposite polarity is applied from below the platen 14 to the film 22 via the conductive platen 14 and pad 12, in one embodiment. The electric field between the film 22 and the counter electrode 16 may be proportional to the voltage difference between the platen 14 and the electrode 16 in one embodiment of the present invention. That electric field drives the electrochemical polish process. The pad 12 serves the dual function of providing an abrasive surface, as well as electrical contact to the film 22 being polished.

Thus, in some embodiments, uniform electrical contact may be made to the film 22 being polished. As a result, the electropolish process may be less dependent on the resistance of the film 22 because a wide contact surface may be had between the film 22 and the pad 12 in some embodiments. As a result, the film 22 removal process may not be significantly slowed or halted in some areas. This may improve the ability to remove the entire film 22 in some embodiments.

While the present invention has been described with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and variations therefrom. It is intended that the appended claims cover all such modifications and variations as fall within the true spirit and scope of this present invention.

What is claimed is: